

WHAT IS CLAIMED IS:

- 1 1. An intake valve control system for an internal
2 combustion engine, comprising:
3 a first valve control mechanism capable of continuously
4 varying an actual operation angle of an intake valve;
5 a second valve control mechanism capable of
6 continuously varying an actual maximum lift phase of the
7 intake valve; and
8 a control unit that operates the first and second valve
9 control mechanisms so as to adjust an intake air amount by
10 controlling the operation angle predominantly in a low-intake
11 range and by controlling the maximum lift phase predominantly
12 in a high-intake range,
13 the control unit being configured to:
14 calculate a target operation angle and a target maximum
15 lift phase in accordance with engine operating conditions so
16 that the actual operation angle and the actual maximum lift
17 phase are controlled to the target operation angle and the
18 target maximum lift phase, respectively; and
19 correct the target operation angle in a transient
20 operating state where the actual maximum lift phase deviates
21 from the target maximum lift phase.
- 1 2. An intake valve control system according to Claim 1,
2 wherein the target operation angle is corrected to become
3 increased when the actual maximum lift phase deviates from
4 the target maximum lift phase toward an advanced side.
- 1 3. An intake valve control system according to Claim 1,
2 the control unit is further configured to judge said transient

3 operating state when either parameter of an accelerator
4 opening and a target intake air amount calculated from the
5 accelerator opening is compliant with the high-intake range
6 and a change rate of the parameter is larger than or equal
7 to a threshold value.

1 4. An intake valve control system according to Claim 1,
2 wherein the control unit is further configured to judge said
3 transient operating state when a phase deviation between the
4 actual maximum lift phase and the target maximum lift phase
5 is larger than or equal to a threshold value.

1 5. An intake valve control system according to Claim 3,
2 wherein the target operation angle is corrected by adding a
3 correction value responsive to the change rate of the
4 parameter to a static target value of the operation angle.

1 6. An intake valve control system according to Claim 4,
2 wherein the target operation angle is corrected by adding a
3 correction value responsive to the phase deviation to a static
4 target value of the operation angle.

1 7. An intake valve control system according to Claim 1,
2 wherein the control unit is further configured to:
3 determine a maximum limit of the corrected target
4 operation angle based on a current value of the actual maximum
5 lift phase; and
6 limit the corrected target operation angle to the
7 maximum limit and below.

1 8. An intake valve control system according to Claim 7,

2 wherein the maximum limit of the corrected target operation
3 angle is determined as an operation angle at which the intake
4 air amount is maximized in the current actual maximum lift
5 phase.

1 9. An intake valve control system according to Claim 7,
2 wherein the maximum limit of the corrected target operation
3 angle is determined by adding an add value responsive to an
4 operational delay of the first valve control mechanism to an
5 operation angle at which the intake air amount is maximized
6 in the current actual maximum lift phase.

1 10. An intake valve control system according to Claim 7,
2 wherein the maximum limit of the corrected target operation
3 angle is determined as a smaller value of an operation angle
4 at which the intake air amount is maximized in the current
5 actual maximum lift phase and a largest operation angle at
6 which interference between the intake valve and an engine
7 piston is avoidable in the current actual maximum lift phase.

1 11. An intake valve control system according to Claim 10,
2 wherein the maximum limit of the corrected target operation
3 angle is determined by selecting a smaller value of an
4 operation angle at which the intake air amount is maximized
5 in the current actual maximum lift phase and a largest
6 operation angle at which interference between the intake
7 valve and an engine piston is avoidable in the current actual
8 maximum lift phase and adding a add value responsive to an
9 operational delay of the first valve control mechanism to the
10 selected smaller value.

1 12. An intake valve control system for an internal
2 combustion engine, comprising:
3 a first valve control mechanism capable of controlling
4 an actual operation angle of an engine intake valve;
5 a second valve control mechanism capable of controlling
6 an actual maximum lift phase of the intake valve;
7 means for calculating a static target operation angle
8 and a target maximum lift phase in accordance with engine
9 operating conditions, the static target operation angle
10 varying predominantly over the target maximum lift phase in
11 a low-intake range, the target maximum lift phase varying
12 predominantly over the static target operation angle in a
13 high-intake range;
14 means for calculating a dynamic target operation angle
15 from the static target operation angle in a transient
16 operating state where the actual maximum lift phase deviates
17 from the target maximum lift phase;
18 means for selecting the dynamic target operation angle
19 under as a final target operation angle under said transient
20 operating state and setting the static target operation angle
21 as a final target operation angle under a state other than
22 said transient operating state; and
23 means for operating the first and second valve control
24 mechanisms so as to control the actual operation angle and
25 the actual maximum lift phase to the final target operation
26 angle and the target maximum lift phase, respectively.

1 13. An intake valve control unit according to Claim 12,
2 further comprising:
3 means for reading an operation parameter and a change
4 rate thereof, the parameter being either an accelerator

5 opening or a target intake air amount calculated from the
6 accelerator opening; and

7 means for judging said transient operating state when
8 the parameter and the change rate of the parameter are larger
9 than or equal to respective threshold values.

1 14. An intake valve control unit according to Claim 12,
2 further comprising:

3 means for determining a phase deviation between the
4 actual maximum lift phase and the target maximum lift phase;
5 and

6 means for judging said transient operating state when
7 the phase deviation is larger than or equal to a threshold
8 value.

1 15. An intake valve control unit according to Claim 12,
2 further comprising means for setting a maximum operation
3 angle limit based on a current value of the actual maximum
4 lift phase,

5 wherein said selecting means selects a smaller value
6 of the dynamic target operation angle and the maximum
7 operation angle limit as the final target operation angle
8 under said transient operating state.

1 16. An intake valve control method for an internal
2 combustion engine, the engine having a first valve control
3 mechanism capable of controlling an actual operation angle
4 of an engine intake valve and a second valve control mechanism
5 capable of controlling an actual maximum lift phase of the
6 intake valve, the method comprising:

7 calculating a static target operation angle and a

8 target maximum lift phase in accordance with engine operating
9 conditions, the static target operation angle varying
10 predominantly over the target maximum lift phase in a
11 low-intake range, the target maximum lift phase varying
12 predominantly over the static target operation angle in a
13 high-intake range;

14 calculating a dynamic target operation angle from the
15 static target operation angle in a transient operating state
16 where the actual maximum lift phase deviates from the target
17 maximum lift phase;

18 selecting the dynamic target operation angle under as
19 a final target operation angle under said transient operating
20 state and setting the static target operation angle as a final
21 target operation angle under a state other than said transient
22 operating state; and

23 operating the first and second valve control mechanisms
24 so as to control the actual operation angle and the actual
25 maximum lift phase to the final target operation angle and
26 the target maximum lift phase, respectively.

1 17. An intake valve control method according to Claim 16,
2 wherein the dynamic target operation angle becomes larger
3 when the actual maximum lift phase deviates from the target
4 maximum lift phase toward an advanced side.

1 18. An intake valve control method according to Claim 16,
2 further comprising:

3 reading an operation parameter and a change rate
4 thereof, the parameter being either an accelerator opening
5 or a target intake air amount calculated from the accelerator
6 opening; and

7 judging said transient operating state when the
8 parameter and the change rate of the parameter are larger than
9 or equal to respective threshold values.

1 19. An intake valve control method according to Claim 16,
2 further comprising:

3 determining a phase deviation between the actual
4 maximum lift phase and the final target maximum lift phase;
5 and

6 judging said transient operating state when the phase
7 deviation is larger than or equal to a threshold value.

1 20. An intake valve control method according to Claim 16,
2 further comprising setting a maximum operation angle limit
3 based on a current value of the actual maximum lift phase,

4 wherein, in said selecting, a smaller value of the
5 dynamic target operation angle and the maximum operation
6 angle limit is selected as the final target operation angle
7 under said transient operating state.